

AMENDMENT TO THE DRAWINGS

The attached four (4) Replacement Sheets of drawings includes amendments to Figures 1B, 4, 6, 8 and 11.

In particular, Figure 1B has been amended to show a communication connection between storage array 153 and array controller 152 through interface 157. Support for this amendment can be found at least at paragraph [40], lines 3-5, of the originally filed patent application.

Figure 4 has been amended to correctly show the two blocks of each of stripes 1-3 have failed. Support for this amendment can be found at least at paragraph [43], lines 5-6, of the originally filed patent application.

Figure 6 has been amended to correctly show the array of Figure 5 after performing a dodging operation in which the element of stripe 3 on unit D9 has been donated to stripe 1, and to show the rebuilt data as underlined. Support for this amendment can be found at least in paragraph [45], lines 3-5, of the originally filed patent application.

Figure 8 has been amended to correctly show as underlined the rebuilt data of an element of stripe 3 on unit D9 that has been donated to stripe 1. Support for this amendment can be found at least at paragraph [47], line 2, of the originally filed patent application.

Figure 11 has been amended to correctly show as underlined the rebuilt data of an element of stripe 4 on storage unit D3 that has been donated to stripe 3, the rebuilt data of an element of stripe 8 on storage unit D10 that has been donated to stripe 2, and the rebuilt data of an element of stripe 12 on storage unit D17 that has been donated to stripe 1. Support for this amendment can be found at least at paragraph [56], lines 2-6, of the originally filed patent application.

Attachment: Four (4) Replacement Sheets for Figures 1B, 4, 6, 8 and 11.

REMARKS

The Office Action dated April 7, 2008, has been carefully reviewed, and in view of the above changes and following remarks reconsideration and allowance of all the claims pending in the application are respectfully requested.

Claims 1-23 and 46-95 stand rejected, and claims 24-45 and 96-144 stand withdrawn. By this Amendment, claims 1-6, 8-23, 46, 49-53, 56-73, 76-78 and 81-83 have been amended, and the specification and the figures have been amended. Claims 1-23 and 46-95 remain pending, and claims 24-45 and 46-95 remain withdrawn with a request for consideration of non-elected Species II (independent claims 24 and 96) and Species III (independent claim 118) as provided by 37 C.F.R. § 1.141.

Amendments To The Specification

Applicants have amended the specification, as set forth above, to correct several informalities. Applicants respectfully submit that these changes do not narrow claim scope and no prosecution-history estoppel results from the amendments.

Amendments To The Claims

Applicants have amended claims 1-6, 8-23, 46, 49-53, 56-73, 76-78 and 81-83 to generally improve their respective forms in accordance with U.S. patent law.

Applicants respectfully submit that the amendments to the claims are intended to better clarify the meaning of the claimed subject matter in view of the rejection based on 35 U.S.C. § 112, second paragraph, and in some cases broaden the scope of the claims.

Moreover, Applicants respectfully submit that because the amendments to the claims are not in response to applied art, are directed to formal matters, and do not narrow the scope of the amended claims, no prosecution-history estoppel results from the amendments.

The Amendments To The Figures

Applicants have amended Figures 1B, 4, 6, 8 and 11, and have attached as an Appendix four (4) Replacement Sheets of drawings that include the amendments to Figures 1B, 4, 6 8 and 11.

In particular, Applicants have amended Figure 1B to show a communication connection between storage array 153 and array controller 152 through interface 157. Support for this amendment can be found at least at paragraph [40], lines 3-5, of the originally filed patent application.

Applicants have amended Figure 4 to correctly show the two blocks of each stripe 1-3 have failed. Support for this amendment can be found at least at paragraph [43], lines 5-6, of the originally filed patent application.

Applicants have amended Figure 6 to correctly show the array of Figure 5 after performing a dodging operation in which the element of stripe 3 on unit D9 has been donated to stripe 1, and to show the rebuilt data as underlined. Support for this amendment can be found at least in paragraph [45], lines 3-5, of the originally filed patent application.

Applicants have amended Figure 8 to correctly show as underlined the rebuilt data of an element of stripe 3 on unit D9 that has been donated to stripe 1. Support for this amendment can be found at least at paragraph [47], line 2, of the originally filed patent application.

Applicants have amended Figure 11 to correctly show as underlined the rebuilt data of an element of stripe 4 on storage unit D3 that has been donated to stripe 3, the rebuilt data of an element of stripe 8 on storage unit D10 that has been donated to stripe 2, and the rebuilt data of an element of stripe 12 on storage unit D17 that has been donated to stripe 1. Support for this amendment can be found at least at paragraph [56], lines 2-6, of the originally filed patent application.

The Rejection Under 35 U.S.C. § 112, Second Paragraph

Claims 1, 46 and 73 and the intervening claims stand rejected under 35 U.S.C. § 112, second paragraph, as it is unclear to the Examiner what the relationship is between “k” and “m” or what values variables “k” and “m” take on.

Applicants respectfully submit that the relationship between “k” and “m” in claims 1, 46 and 73 is that “k” and “m” are integers. Support for this explanation can be found throughout the specification, for example, at least at paragraph [19], lines 4-7, paragraph [21], lines 3-7, and paragraph [22], lines 3-7, of the originally filed patent application. Further, claims 4, 51 and 76 provide a more detailed relationship between “k” and “m” as follows:

$$n = r,$$

$$n \geq 2, \text{ and}$$

$$jm = k(n + r),$$

in which

n is the number of data units in the base array;

r is the number of redundant units in the base array;

m is the number of storage units in the array; and

j and k are integers.

The variables “ n ” and “ r ” are integers because the number of data units in the base array and the number of redundant units in the base array are integers. Variables “ j ” and “ k ” are defined to be integers. Accordingly, variable “ m ” is an integer. Support for this explanation can be found throughout the specification, for example, at least at paragraph [19], lines 4-7, paragraph [21], lines 3-7, and paragraph [22], lines 3-7, of the originally filed patent application.

The Examiner also indicates that it is unclear to the Examiner as to

*“what is meant by 'each stripe forming an erasure or error correcting code having a minimum Hamming distance d , selecting an element in a **donor stripe** when a difference between a minimum distance of the **donor stripe** and a minimum distance of a **recipient stripe** is greater or equal to 2, the selected element being stored on a storage unit having no elements of the recipient stripe; and rebuilding a lost element of the recipient stripe on the selected element' in **Claims 1,46,73.**”*

Applicants respectfully submit that a “stripe” is a base array within an array. (See, for example, paragraph [07] of the originally filed patent application.) A “base array” is a set of elements that comprise an array unit for an Erasure or Error Correcting Code (ECC). (See, for example, paragraph [05] and paragraph [37], lines 1-5, of the originally filed patent application.) Thus, each stripe of the claimed k stripes forms an erasure or error correcting code having a minimum Hamming distance d .

Applicants respectfully submit that a “donor” stripe is a stripe of the claimed k stripes that are stored across an array of m storage units such that the “donor” stripe has a minimum Hamming distance d_i that is at least 2 greater than the Hamming distance d_j of another stripe (the “recipient” stripe) of the k stripes that are stored across the m storage units, that is, when $d_i \geq d_j + 2$. The “donor” characterization comes from the fact that one of the elements of the

“donor” stripe will be selected to be “donated” to the stripe having a Hamming distance $d_j \leq d_i - 2$. Hence, the stripe receiving the “donated” element is referred to as a “recipient” stripe. According to the subject matter disclosed herein, the element selected from the “donor” stripe is stored on a storage unit comprising no elements of the recipient stripe. The “donated” element is used for rebuilding an element that has been lost from the “recipient” stripe. After the lost element has been rebuilt on the “donated” element, the Hamming distance of the “donor” stripe will be reduced by 1, and the Hamming distance of the “recipient” stripe will be increased by 1. Support for this explanation can be found throughout the specification, for example, at least at paragraph [38] of the originally filed patent application.

The Examiner indicates that “[i]t is also *unclear* to the Examiner how error tolerance is increased in **Claims 1, 46, 73** and intervening claims.”

The minimum Hamming distance of an array of m storage units, in which k stripes are stored across the array of m storage units, is the minimum Hamming distance of all of the Hamming distances of the respective stripes stored across the array of m storage units. (See, for example, paragraph [15], lines 9-11, of the originally filed patent application.) The subject matter of the present patent application relates to a technique for increasing the error tolerance of the array by increasing the Hamming distance of the stripe having the minimum Hamming distance all of the Hamming distances of k stripes stored across an array of m storage units. According to the subject matter disclosed in the present patent application, the technique can be performed when the difference between the minimum Hamming distance d_i of a “donor” stripe and the Hamming distance d_j the “recipient” stripe is $d_i \geq d_j + 2$. When this condition is met, one of the elements of the “donor” stripe is selected to be “donated” to the “recipient” stripe, and a lost element of the “recipient” stripe is rebuilt in the “donated” element. After the lost element has been rebuilt on the “donated” element, the Hamming distance of the “donor” stripe will be reduced by 1 and the Hamming distance of the “recipient” stripe will be increased by 1, thereby increasing by 1 the minimum Hamming distance of all of the Hamming distances of the k strips stored across an array of m storage units. Accordingly, the error tolerance of the array of m storage units has also been increased by 1. Support for this explanation can be found throughout the specification, for example, at least at paragraph [38] of the originally filed patent application.

Consequently, Applicants respectfully request that the Examiner withdraw this rejection and allow claims 1-23 and 46-95.

The Rejection Under 35 U.S.C. § 112, Fourth Paragraph

Claim 2, 49 and 74 stand rejected under 35 U.S.C. § 112, fourth paragraph, as failing to further limit their respective independent claims.

Applicants respectfully submit that claims 2, 49 and 74 further limit their respective independent claims. Regarding claim 2, claim 2 relates to a relationship of the value of the Hamming distance of the recipient stripe with respect to a predetermined number, whereas claim 1 relates to a relationship of the difference between the Hamming distance of the claimed donor stripe and the Hamming distance of the recipient stripe. In this regard, it should be apparent that for claim 1, the base claim of claim 2, the value of the Hamming distance of the recipient stripe can be, for example, $d \geq 1$.

Applicants respectfully submit that claims 49 and 74 have a similar relationship with their respective base claims, claims 46 and 71.

Consequently, Applicants respectfully request that the Examiner withdraw this rejection and allow claims 2, 49 and 74.

Applicants respectfully submit that the foregoing remarks make allowable the single elected species of Species I (i.e., independent claims 1, 46 and 73) identified in the Restriction Requirement dated December 3, 2007. Consequently, Applicants respectfully request consideration of non-elected Species II (independent claims 24 and 96) and Species III (independent claim 118) as provided by 37 C.F.R. § 1.141.

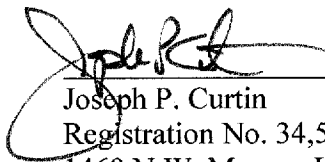
CONCLUSION

In view of the above amendments and arguments/remarks, it is urged that the present application is now in condition for allowance. Should the Examiner find that a telephonic or personal interview would expedite passage to issue of the present application, the Examiner is encouraged to contact the undersigned attorney at the telephone number indicated below.

It is requested that this application be passed to issue with claims 1-144.

Respectfully submitted,

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